Respiratory Distress Followed By Cardiac Arrest in a Pregnant Patient in the Emergency Department
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Disclosures: This presenter has no financial relationships with commercial interests.

Stem Case and Key Questions Content
A 25-year-old morbidly obese 5’7”, 340 lbs. (BMI=53.6) woman G4 P3 at 38 weeks gestation is brought in by ambulance with respiratory distress/failure. She is on a stretcher with the head elevated and is being assisted via bag-mask ventilation. Paramedic responder reports that the patient had been “apneic” in the ambulance a couple of times and needed assisted ventilation via bag-mask. Her past medical history is significant for asthma and she had in fact been seen at a nearby hospital for status asthmaticus just one day before but had signed out against medical advice. Her prenatal care had been given at that hospital as well. She has a large neck mass which she refused to get evaluated. Upon examination she is found to have wheezes bilaterally with poor air exchange. On 100% non-rebreather mask her saturation is in the low to mid 80s and she is somewhat uncooperative and agitated.

1. What concerns would you have about this “neck mass”?
2. Could the “neck mass” have anything to do with her respiratory distress?
3. What is the differential diagnosis of wheezes?
4. What is most likely the cause of wheezes in this patient?
5. If you had been called down to intubate this patient, what would be your plan and would you want any other service to be immediately available as well?

The obstetrician and neonatologist are called down to the Emergency Department (ED) and they arrive with the neonatal resuscitation equipment. The obstetrician confirmed and documented presence of a fetal heartbeat via sonography with no signs of fetal distress. The ED physician treated her with Albuterol, Solumedrol and epinephrine and her saturation did not improve significantly, whereupon she was placed on Bilevel Positive Airway Pressure (BiPAP). After a trial of BiPAP it was determined that she was not improving as the arterial blood gas had a pH=6.9 with CO2 of 90 mm Hg. The decision was made by the ED physician to intubate the patient. She was
then given Propofol and Succinylcholine x 2 in an attempt to secure the airway. Laryngoscopy was performed with a Glidescope® and two attempts were made to pass the endotracheal tube, but were unsuccessful. At that time the anesthesiologist was called to assist in securing the airway.

6. What are the indications and what are the complications associated with BiPAP?
7. Was BiPAP appropriate in this case?
8. What is the practice in your facility with respect to the securing the airway of patients who come into the Emergency Department? Straightforward airway vs. difficult airway?
9. Is there a difference in the types of medications used for intubation in the ED when performed by anesthetists vs. ED physicians?
10. At what point do you believe an anesthetist should have been called?

Upon arrival the anesthesiologist notices that the patient has a very large neck mass and he asks the operating room to send another anesthesiologist for assistance. At the same time the anesthesiologist requested an LMA and performed direct laryngoscopy with a MAC 3 blade and intubated the patient with a #7.5 ETT; he later described a Grade II view. The disposable EZ-Cap® was attached to the ETT and there was evidence of color change witnessed by both anesthesiologists and the respiratory therapist. Initially her saturation improved, but shortly thereafter it started to deteriorate, at which point she sustained a cardiac arrest. The patient’s significant other wanted to remain present during the resuscitation and refused to leave at which point the hospital police escorted him out of the trauma bay.

11. What are the options for securing the airway of a patient with a large neck mass?
12. Would an LMA have worked in this case?
13. What are the different devices that can be used outside of the operating room to confirm proper placement of an endotracheal tube?
14. What are the most common causes of cardiac arrest in the pregnant patient?
15. What are the management recommendations when treating a pregnant patient who sustains a cardiac arrest?
16. Would it have been appropriate for the family to remain present during the resuscitation? ACLS was initiated and the obstetrician began a perimortem cesarean delivery (PMCD) with a tray that had been brought down to the ED from the labor and delivery suite (4 floors up and in another connecting building). Cardiac arrest time to neonate delivery was between 5 and 6 minutes. The APGARs were 1 at 1 minute and 2 at 5 minutes.

17. What instruments should be available in the ED for such an unexpected case?
18. What are the benefits of performing a c-section at this time?
19. Does the fetus have to be viable in order to make the decision to perform a c-section or is a hysterotomy indicated for a fetus that is not viable?
20. At what size uterus does obstruction to uteroplacental flow occur?

21. Would your thinking change in the situation where a pregnant patient has undergone an unwitnessed cardiac arrest?

After intubation there are decreased breath sounds on the right side, along with crepitus and there is a suspected pneumothorax. Needle decompression is performed with a resultant “gush” of air and the surgeon inserts a chest tube. The patient then develops a shockable rhythm and resuscitation continues unsuccessfully for 45 minutes, at which time she is pronounced dead.

22. Who should be on the team to resuscitate a pregnant patient who sustains a cardiac arrest?

23. Who should “call the shots” or be the “captain”?

24. Does your Code Team have special training related to responding to cardiac arrests in pregnant patients?

25. What would be your advice to ED physicians regarding when to call an anesthetist?
### Extrathoracic Upper Airway
- Anaphylaxis
- Vocal cord edema or paralysis
- Paradoxic vocal cord motion
- Laryngeal stenosis
- Laryngoele
- Tonsillar hypertrophy
- Goiter
- Postnasal drip syndrome

### Intrathoracic Central Airway
- Tracheal stenosis
- Tracheal and bronchial tumors
- Respiratory papillomatosis
- Tracheomalacia, tracheobronchomalacia
- Hyperdynamic airway collapse
- Relapsing polychondritis
- Tracheobronchial amyloid
- Mucus plugs
- Vascular rings and aneurysms
- Mediastinal mass

### Intrathoracic Lower Airways
- Bronchiectasis
- Bronchiolitis
- Bronchiolitis obliterans
- Cardiac asthma
- Carcinoid tumors
- Occupational causes of nonasthmatic wheezes
- Parasitic infection
- Reactive airways disease syndrome
- Airway distortion
- Focal wheeze

### Obstetric Causes of Cardiac Arrest in Pregnancy
- Postpartum Hemorrhage
- Amniotic Fluid Embolism
- Eclampsia
- HELLP
- Preeclampsia
- Uterine Atony
- Peripartum cardiomyopathy
- Magnesium toxicity

### Non-obstetric Causes of Cardiac Arrest in Pregnancy
- Cardiac Disease
- Sepsis
- Thromboembolism
- Anesthetic complications
- Aortic Dissection
- Trauma
- Bleeding (non-uterine)
- DIC
- Cerebrovascular Accident
- Cardiac Disease (Acute Coronary Syndrome, myocardia infarction)
Cardiac Arrest Gravid Patient

More than 20 weeks by dates or uterus at or above umbilicus

No

Continue ACLS

At 4 minutes decide on PMCD and deliver within the next minute

Yes

LUD 30°
Activate OB Cardiac Arrest Team

5 MINUTES MAXIMUM

Perfom PMCD/ hysterotomy
resuscitate neonate
Continue ACLS

Figure 1
Model Discussion Content

DIFFERENTIAL DIAGNOSIS OF WHEEZES

Remembering the adage, “All that wheezes is not asthma; all that wheezes is obstruction” we need to evaluate this patient to determine the source of the wheezes. Typically, one thinks of wheezing as that associated with COPD and asthma; conditions characterized by bronchoconstriction and excessive mucus production with inability or difficulty clearing these secretions. However, there are other conditions that can lead to limited airflow that may exist separately or in concert with COPD and asthma. Because of this it can be challenging to determine which is which and how it should be treated or controlled.1 There might be two processes going on simultaneously.

Wheezes are described characteristically as high pitched with notes of all ranges. They can be inspiratory, expiratory or both. Wheezes can be generated from airways of any diameter and the sounds result from movement of the opposing walls of the airway, causing narrowing.1 This should not be confused with stridor, which tends to be inspiratory, high pitched and heard best over the anterior neck. We can further breakdown wheezes into three categories: extrathoracic upper airway, intrathoracic central airway and intrathoracic lower airways (table 1).

In a patient with a neck mass and respiratory compromise/distress one must consider the possibility of upper airway collapse as a result of the mass that might in fact extend substernally, especially if it originates from the thyroid. A preintubation evaluation of the airway is the best way to assess the extent of the disease and the options available to secure the airway, in a safe setting. Evaluation should include chest x-ray to identify the presence and extent of deviation of the trachea, a CT scan to delineate the extent of the mass and any narrowing of the airway, flow-volume loops to determine if the airway behaves differently depending on position and a comprehensive history from the patient concentrating on exacerbations of symptoms in different positions.2 Flow-volume loops are especially helpful in distinguishing between intrathoracic and extrathoracic lesions. What is of major concern is the dynamic lesion that narrows the airway and extends beyond the tip of an ETT or tracheostomy tube and the airway that collapses upon lying supine or with the institution of positive pressure ventilation. Depending on the extent and location of the disease one can plan for something as straightforward as a standard intravenous induction and intubation to a more complex technique such as an awake fiberoptic intubation with the patient breathing spontaneous throughout or even intubation with a rigid bronchoscope.3

Ideally a patient with a neck mass who has had no previous evaluation and when time does not allow for such would be best intubated in a controlled setting such as an operating room with an otolaryngologist to perhaps perform a tracheostomy (if possible) or insert a rigid bronchoscope.
beyond the lesion. A rigid bronchoscope positioned beyond the lesion would act like a stent and keep the airway patent.

BiPAP AND AIRWAY MANAGEMENT IN THE EMERGENCY DEPARTMENT

Bilevel Positive Airway Pressure Ventilation (BiPAP) was first used in the 1980s for the treatment of respiratory failure of a chronic nature such as sleep apnea, respiratory muscle fatigue and thoracic cage deformities. Eventually its use was expanded to treat acute conditions such as the exacerbation of COPD, status asthmaticus, congestive heart failure, pneumonia and pulmonary edema. BiPAP decreases the work of breathing by increasing the functional residual capacity leading to improved ventilation-perfusion (V/Q) matching. Two advantages of BiPAP are that it can be used comfortably in the pediatric population and there is no risk of ventilator associated pneumonia. In the asthmatic patient, intubation is considered a “measure of last resort” due to the higher risk of barotrauma, increased length of stay, muscle weakness and mortality. BiPAP has very infrequent complications such as skin abrasions, barotrauma, reduced cardiac output and gastric distention with the risk of aspiration. Several of these complications are more theoretical than practical.

Because the process of instituting BiPAP requires several steps that take time and requires patient cooperation and understanding, it is not a good choice in a case where the patient is in immediate jeopardy of a respiratory arrest. Additionally, it is not indicated in patients who have excessive secretions, altered mental status or who are over 135 kg. Once it is instituted, the patient must be under constant surveillance as failure and rapid deterioration will require immediate intubation. There remains controversy as to who should intubate the patient with a difficult airway who comes to the emergency department (ED). In institutions that do not have an anesthetist in house 24/7 it is an easy decision. However, in hospitals that are staffed with an anesthetist and emergency room physicians who are trained in intubation the decision is less clear. We have all been called down to the ED to intubate a patient after the ED physician has attempted 2-3 times, with no success. At that point one is faced with a bloody and sometimes edematous airway that now becomes our challenge. Pregnant patients are often difficult intubations and therefore should be intubated by a clinician who has the most experience with intubations as well as familiarity with “rescue” techniques. This is most often an anesthesiologist.

In a study published in the Emerg Med J. in 2007, Reed attempted to determine when one becomes “competent” at intubation. He pointed out that the paramedic industry has published on this issue several times, but the Emergency Medicine community had never approached it. In Reed’s prospective study of the first 100 intubations performed by a sole emergency medicine physician, himself, he found that as the number of intubations increased, the type of “complication” encountered changed from something common like an esophageal intubation with early attempts to more serious complications such as failure to achieve an adequate view, thus requiring a more experienced practitioner to complete the procedure successfully. He also stated that the complication rate seems
to decrease after about 30 intubations. The US National Emergency Airway Registry (NEAR) is a database that reports on emergency room intubations. Among emergency room residents they record an overall 83% success rate for first attempts with an increase to 93% for PGY 4+ residents. Another debate among anesthetists and emergency medicine physicians pertains to the use of muscle relaxants to facilitate intubation outside of the operating room. Anesthesiologists and nurse anesthetists have been trained in the art of the “awake intubation” sometimes with a little sedation, sometimes with just a topical anesthetic and less frequently with nothing at all. It is now routine practice for Emergency Medicine (EM) physicians to use muscle relaxants in the ED, a practice not well supported by anesthesiologists. Most of the literature in support of RSI by non-anesthesiologists comes from EM journals and therefore is somewhat biased. And the majority of these reports are retrospective. Although usually successful in this practice it appears that further collaboration and education between the two disciplines would be beneficial.

ED physicians and anesthesiologists are also at odds when it comes to the choice of muscle relaxant used for a rapid sequence induction outside of the operating room. Succinylcholine has many side effects; hyperkalemia, bradycardia in the pediatric patient, increased ICP and IOP and the risk of malignant hyperthermia. Rocuronium seems a reasonable alternative NMBA with onset in appropriate doses almost as rapid as Succinylcholine, and devoid of the side effects mentioned. However, because it is an intermediate acting rather than a short-acting NMBA, Succinylcholine remains the drug of choice for EM physicians for RSI. However it is not uncommon for an ED physician to use an intermediate NMBA in the ED with much more comfort than an anesthesiologist. There are a number of devices or methods to confirm correct placement of an endotracheal tube outside of the operating room, one of the most common being the EZ-Cap® or similar qualitative CO2 devices. Others methods include continuous end-tidal carbon dioxide monitoring (quantitative), confirmation by bronchoscope, esophageal detector and even ultrasound. None of these methods is 100% reliable, particularly in a patient who has poor circulation as in the situation of cardiac arrest. In fact most of the false negatives with CO2 detectors have been in patients who were in cardiac arrest. Esophageal intubations may yield a false positive for the first few breaths as mask ventilation might have forced CO2 into the stomach.

Therefore in addition to visualizing the tube pass between the vocal cords it is recommended that two methods be employed in order to confirm correct placement of the endotracheal tube. The esophageal bulb device (EBD) or esophageal detector device (EDD) have both been studied prospectively. In one observational study there were 104 EBD assessments performed in 53 patients who were intubated out of hospital. The EBD identified four out of the five esophageal intubations and ninety-six of the ninety-nine tracheal intubations. This calculates to a sensitivity of 80%, a specificity of 97% and overall accuracy of 96%. In another similar study where an EDD was compared to capnography a group of 48 adults were intubated out of hospital and the EDD detected all eight
esophageal intubations and 34 of the 48 tracheal intubations that calculates to a sensitivity of 70.8%.

Another useful technique is the Tracheal Rapid Ultrasound Exam (T.R.U.E.). In an observational prospective study of 112 patients they found that the use of the T.R.U.E was 98.9% sensitive, 94.1% specific and had an overall accuracy of 98.2% in those that were skilled in its use. This is truly a test that can be performed rapidly. It stands to reason that a combination of at least two of these techniques would with a great deal of accuracy determine the correct placement of the endotracheal tube, even in the situation of cardiac arrest.

CARDIAC ARREST IN THE PREGNANT PATIENT
There are obstetric and non-obstetric causes of cardiac arrest in the pregnant patient (table 2). The pregnant patient presents a unique set of problems with respect to intubation. In addition to being classified as a "full stomach" after 10-12 weeks of gestation, there is often mucosal edema and swelling leading to a more delicate airway that is easily traumatized especially if intubation is attempted through the nares. Additionally, the decreased functional residual capacity and increased oxygen consumption causes a smaller margin for error especially in the pregnant patient who is in respiratory distress. It has been reported that failed intubation increases 8x in the pregnant patient and therefore one should be equipped with all necessary devices to aid what might be a difficult intubation including a Glidescope®, intubating LMA, bougies, fiberoptic bronchoscope or whatever device with which one is most comfortable. This would also support the practice of having the clinician with the most experience intubate such a patient, usually an anesthesiologist.

When a pregnant patient with a nonviable fetus is in cardiac arrest or impending cardiac arrest and the uterus is over 20-week size, the obstetricians must be immediately available to perform a peri-mortem cesarean delivery (PMCD) or hysterotomy. Until this can be done, CPR must be performed either with the uterus tilted 30 degrees or with someone manually displacing the uterus off of the great vessels. It has even been suggested that regardless of the size of the uterus, uterine displacement is paramount in restoring circulation. In the case where the fetus is viable (over 24 weeks) the neonatologists must also be available with all of their resuscitative equipment and plans that might even entail transfer of the neonate to a more highly skilled facility.

It has been the practice of many hospitals to escort family members out of the room when a loved one sustains a cardiac arrest. The reasons cited for this routine include trauma to the family, disruption to the caregivers (demonstrated in simulation exercises) and the fear of medico-legal claims citing what was witnessed during the resuscitation. A study performed in France and published in the New England Journal of Medicine in March 2013 found these concerns to be unfounded. They created two groups, an intervention group and a control group. The former were invited to watch CPR (if desired) while the latter followed standard practice that did not encourage their presence, but allowed for it if
they do not leave the room on their own. What they found was that the frequency of PTSD-related symptoms was significantly higher in the control group (P=0.004) and that relatives who were not present during CPR had a higher incidence of anxiety and depression. Those who were not present somehow felt “robbed” of the opportunity to be with the loved one during his/her last moments of life. In addition, the medical team did not report experiencing any more anxiety due to the presence of the family nor did they feel any extra stress or interference. 21,22

What is important to point out about this study is that the CPR was being performed in a pre-hospital setting (often in the individual’s home) which does not compare to the more invasive procedures that are instituted in the hospital setting, such as arterial punctures in the femoral vessels, insertion of central lines in the neck and sometimes defibrillation. It is also believed by some that if the family member is to be present in the hospital room, ICU or ED bay, that there should be a trained professional present to explain to them what is transpiring. There is even evidence that suggests having family members watch the attempts at resuscitation will ensure the family that “everything was done” and might give them pause to request that “everything be done” going forward. 23

CPR IN THE PREGNANT PATIENT Fortunately situations in which one would have to perform a peri-mortem cesarean delivery (PMCD) or hysterotomy are rare, but have taken place in EDs, ICUs, Labor and Delivery Suites and even in radiology suites. The situation is unique in that one is dealing with the mother and what in many instances is a viable fetus. The Society for Obstetric Anesthesia and Perinatology published a Consensus Statement on the Management of Cardiac Arrest in Pregnancy in 2014.19 It served to complement the 2010 American Heart Associate Guidelines Part 12.3, Cardiac Arrest Associated with Pregnancy and Maternal Cardiac Arrest Algorithm.24 Cardiac arrest in pregnancy occurs in only 1:20-50,000 women and because it is so rare the special considerations not routinely taught in BLS, ACLS or ATLS courses. However caring for the pregnant patient who has sustained a cardiac arrest presents issues that require specialized treatment and handling, especially when it comes to making a decision to perform a PMCD or hysterotomy.25

Recommendations for the administration of CPR in the patient with a 20+ week gravid uterus are much the same as they are for average non-gravid patient; circulation, then airway, then breathing, hard and fast chest compressions, early use of defibrillator, use of algorithm for medication dosing, interruption of chest compressions for MINIMAL periods of time, use of an external defibrillator if those involved in the code are not well versed in reading EKG strips and the switching of the person performing compressions every two minutes to prevent fatigue. It is however stressed in the resuscitation of the patient with a gravid uterus that i.v. access be secured in the upper torso due to the aortocaval compression, that the compressions be performed 2-3 cm higher on the sternum in the third trimester compared to average person, that time not be wasted by transporting the patient to the operating room, that a skilled obstetrician needs only a scalpel and a few clamps to perform a c-
section and that if the decision is made to perform a PMCD that the fetus be delivered within 5 minutes of the cardiac arrest.

Another recommendation pertains to who the “leader” of the code should be. In the SOAP consensus statement it is suggested that someone familiar with the physiology of the pregnant patient, the possible need for PMCD and confident with the special needs required in successfully resuscitating a pregnant patient lead the team. The American Heart Association even recommends the creation of an OB cardiac arrest team that would comprise of members from the NICU, Adult ICU, Obstetrician and transportation of instruments and infant resuscitation equipment. Again, although this is a rare occurrence, the ED should have a complete cesarean section tray on hand since the infant needs to be delivered within five minutes of cardiac arrest in order to decrease the possibility of neurological complications.24 (figure 1)

References
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